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AMERICAN NATIONAL STANDARD

Preferred SI Units for Machine Tools

ANSI B5.51M - 1979

SECRETARIAT

SOCIETY OF AUTOMOTIVE ENGINEERS
SOCIETY OF MANUFACTURING ENGINEERS
NATIONAL MACHINE TOOL BUILDERS ASSOCIATION
AMERICAN SOCIETY OF MECHANICAL ENGINEERS

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FOREWORD

The manufacturers and users of machine tools, following many years of use of the customary or inch units of measurement, had developed a rationalized list of preferred units and symbols for selected quantities for machine tools. This was essential for conversational and documentary clarity and uniformity.

Example: The inch has been used when specifying dimensions and tolerances of engineering drawings; feet and/or yards have been avoided. Spindle speeds have normally been stated in revolutions per minute; revolutions per second or hour have been avoided.

As the SI units and symbols began to be used in place of the customary units and symbols, it became apparent that a practical rationalization of the many choices of these units was needed for machine tool use.

Several years ago the main committee of ANSI B5 discussed the possible need of this preferred list of SI units and symbols for use on machine tools. As a result of this expressed need a preliminary list was prepared under the direction of ANSI B5 by Mr. Walter Nahrup.

The list was circulated widely to many manufacturers and users of machine tools and all comments received were a positive expression of the need for a preferred list of SI units and symbols.

Following the review of comments resulting from circulation here in the United States and a review with international authorities, the list was updated and received further circulation, review and testing.

The main committee of ANSI B5, following further discussion and review, unanimously agreed to recommend the United States standardization of this list of Preferred SI Units and Symbols for Machine Tools.

The units already in common use in the United States and throughout the world that are acceptable in the SI system were maintained wherever practical. This was essential to avoid any unnecessary confusion as we move to the use of SI units.

Example: Revolutions per minute are preferred; revolutions per second or revolutions per hour are not recommended.

Where unique SI units were selected, the unit that could be stated in the most easily used number or range of numbers was usually selected.

Example: Cutting speed in the customary units has been stated in feet per minute. The range in normal use in machine tools is approximately 50 feet per minute to 2000 feet per minute. Meter per minute has been selected as the preferred SI unit. The minute is maintained as the span of time. The meter was selected as the unit of space thus the normal range will be approximately 15 meters per minute to 610 meters per minute.

This Standard, following approval by the Standards Committee and the Sponsor was approved as an American National Standard on February 9, 1979 and designated B5.51M-1979.

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AMERICAN NATIONAL STANDARD

PREFERRED SI UNITS FOR MACHINE TOOLS

1.0 SCOPE

1.1 This Standards gives the preferred choice of selected SI units, multiples, submultiples and symbols for selected quantities for machine tool use.

1.2 These preferred SI units, multiples, submultiples and symbols, are for use on engineering drawings, machine test documents, customer machine quotations, operator instruction plates, operator instruction manuals, machine tool specification catalogs and other related documents.

2.0 PURPOSE

The purpose of this Standard is to:

2.1 Rationalize the expression of SI units and their multiples and submultiples for given quantities for machine tools.

2.2 Establish a uniform use of these selected SI units and their multiples and submultiples for machine tools.

2.3 Establish conversational and documentary uniformity and clarity in the use of SI units and their multiples and submultiples for machine tools.

3.0 GENERAL

3.1 All units are listed for use in their normally accepted practical values.

3.2 Units that are used to show more than one value for a common quantity should use the same multiple for all items.

Example: Machine feed rates (0.12 mm per min to 10 000 mm per min)

The use of mm remains consistent in the example.

3.3 Machine tool design calculations and other related scientific and educational needs may include the use of these selected units. For these activities it is also recognized that greater freedom in the use of all SI units and their multiples and submultiples will be required and reference is made to ISO 1000 and relevant parts of ISO R31.

4.0 TABLES

4.1 A number of selected commonly use quantities for machine tool use are given in the following tables.

4.2 The preferred choice of SI units to express these quantities are given along with their preferred multiple and submultiple choices.

4.3 To allow for a logical and orderly transition to the use of SI units in the inch using countries as well as in those countries that produce documentary data in both metric and inch units, the commonly used customary or inch unit and symbol have been shown for reference for each selected quantity.

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Table 1 Space and Time

	Quantity	Selected SI Unit	SI Unit Symbol	Customary Unit	Customary Symbol	Remarks
1-1 Space—Distance						
1-1.1	angular allowance for accuracy	degree, minute, second	°, ′, ″	degree, minute, second	deg. min sec.	*
1-1.2	feed per tooth	millimeter	mm	inch	in	
1-1.3	geometric tolerances-roundness, etc.	millimeter	mm	inch	in	
1-1.4	grind tolerance	millimeter	mm	inch	in	
1-1.5	length-depth (general)	millimeter	mm	inch	in	
1-1.6	length-cable	meter	m	foot	ft	
1-1.7	pick-feed grinders	millimeter	mm	inch	in	
1-1.8	shipping size	meter	m	feet	ft	
1-1.9	surface finish-roughness height	micrometer	μm	millionth of inch	μ in	
1-1.10	threads-Lead or pitch	millimeter	mm	threads per inch	th/in	

*Where desired, the angle may be given in degrees and decimal parts of a degree and the tolerance in decimal parts of a degree.

1-2 Space—Area/Volume						
1-2.1	area (general)	square meter	m^2	square feet	sq ft	
1-2.2	capacity-reservoir	liter	L	gallon	gal	
1-2.3	Shipping cubic content of equipment	cubic meter	m^3	cubic feet	cu ft	
1-3 Time						
1-3.1	time	second, minute, hour	s, min, h	second, minute, hour	sec, min, hr	
1-3.2	time-tool change	second		second	sec	
1-3.3	time-to grind part	minute	min	minute	min	
1-4 Space—Time						
1-4.1	acceleration	meters per second per second	m/s^2	inches per second per second	in/sec^2	
1-4.2	capacity-pump	liters per minute	L/min	gallons per minute	gal/min	
1-4.3	feed per revolution	millimeters per revolution	mm/r	inches per revolution	in/rev	
1-4.4	feed rate	millimeters per minute	mm/min	inches per minute	ipm	

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Table 1 Space and Time (Cont.)

	Quantity	Selected SI Unit	SI Unit Symbol	Customary Unit	Customary Symbol	Remarks
1-4.5	feed rate-rapid traverse	meters per minute	m/min	inches per minute	ipm	
1-4.6	flow air-small	liters per minute	L/min usually < 1000	cubic feet per minute	cu ft/min	
1-4.7	flow air-normal	cubic meters per minute	m^3/min usually > 1	cubic feet per minute	cu ft/min	
1-4.8	flow-coolant	liters per minute	L/min	gallons per minute	gal/min	
1-4.9	speed-cutting	meters per minute	m/min	feet per minute	ft/min	
1-4.10	speed-surface-grinding wheel	meters per second	m/s	feet per minute	ft/min	
1-4.11	spindle speed	revolutions per minute	r/min	revolutions per minute	RPM	
1-4.12	stroke rate	stroke per minute	stroke/min	stroke per minute	stroke/min	

Table 2 Periodic and Related Phenomena

2-1.1	frequency	hertz	Hz	cycles per second	cps	

Table 3 Mechanics

3-1 Work

3-1.1	energy	joule	J	British thermal unit Calorie foot- pound-force	Btu cal ft lbf	
3-1.2	moment of force (torque)	newton-meter	N · m	pound-force-inch pound-force-foot	lbf-in lbf-ft	
3-1.3	force-clamping	kilonewton	kN	ton	ton	
3-1.4	power-machine	kilowatt	kW	horsepower	HP	
3-1.5	load-table capacity	kilogram	kg	pound	lb	
3-1.6	shipping weight (mass)	kilogram	kg	pound	lb	
3-1.7	thrust in a given axis or feed force-small	newton	N usually < 1000	pound	lb	
3-1.8	thrust in a given axis or feed force-normal	kilonewton	kN usually > 1	pound	lb	
3-1.9	weight (mass)	kilogram	kg	pound	lb	
3-1.10	weight of machine (mass)	kilogram	kg	pound	lb	

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Table 3 Mechanics (Cont.)

	Quantity	Selected SI Unit	SI Unit Symbol	Customary Unit	Customary Symbol	Remarks
3-2 Work + Space/Time						
3-2.1	power per revolution per minute	watts per revolution per minute	W/(r/min)	horsepower per revolution per minute	HP/RPM	
3-2.2	metal removal-milling-turning-grinding	cubic centimeters per minute	cm^3/min	cubic inches per minute	cu in/min	
3-2.3	pressure between surfaces	kilopascal	kPa	pound per square inch	lb/in^2	
3-2.4	pressure-liquid	bar	bar	pounds per square inch	psi	
		kilopascal	kPa			*
3-2.5	sawing rate	square millimeters per minute	mm^2/min	square inches per minute	sq. in/min	
3-2.6	tensile strength	megapascal	MPa	pounds per square inch	psi	

*Use kilopascal for calculations. 1 bar = 10^5 Pa
1 bar = 100 kPa

Table 4 Heat

4-1.1	Temperature	degree Celsius	°C	degree Fahrenheit	°F	

Table 5 Electricity

5-1.1	electric current	ampere	A	ampere	A	
5-1.2	electric resistance	ohm	Ω	ohm	ohm	
5-1.3	voltage	volt	V	volt	v	

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APPENDIX 1

Units and Range of Normally Used Numbers

	Unit	Range in SI Units	Range in Customary Units
1-1.2	feed per tooth	0.05 mm to 0.5 mm	0.002 in to 0.02 in
1-1.3	Tolerance	0.0025 mm	0.0001 in
1-1.4	Tolerance	0.0025 mm	0.0001 in
1-4.3	feed per revolution	0.025 to 2.5 mm/r	0.001 to 0.01 in/rev
1-4.4	feed rate	25 to 1270 mm/min	1 to 50 ipm
1-4.5	feed rate-rapid traverse	12.7 m/min	500 ipm
1-4.6	flow-air-small	280 L/min	10 CFM
1-4.7	flow-air-normal	2.8 m^3/min	100 CFM
1-4.9	speed cutting	15 to 610 m/min	50 to 2000 ft/min
1-4.10	speed-surface-grinding wheel	25 to 76 m/s	5000 to 15000 ft/min
3-1.5	load-table capacity	2270 kg	5000 lb
3-1.7	thrust in a given axis or feed force-small	44.5 to 890 N	10 to 200 lb
3-1.8	thrust in a given axis or feed force-normal	1.1 to 22 kN	250 to 5000 lb
3-2.2	metal removal	16.4 to 1640 cm^3/min-milling 4 to 32 cm^3/min—grinding	1 to 100 cu in/min 0.25 to 2 cu in/min
3-2.4	pressure-liquid	5.5 to 345 bar 550 to 34500 kPa	80 to 5000 psi
3-2.5	sawing rate	160 to 6450 mm^2/min	0.25 to 10 sq in/min

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